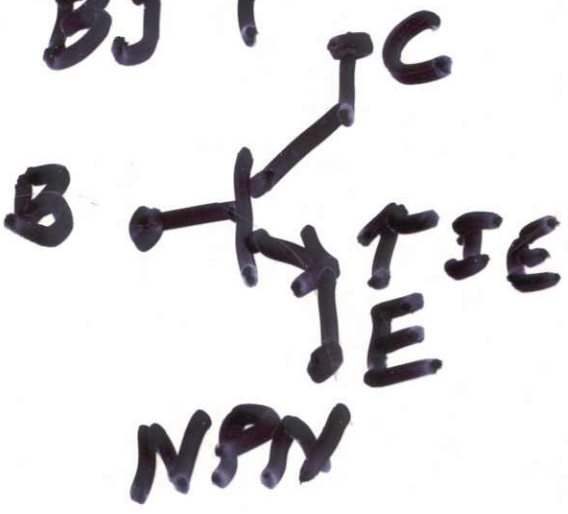
Digital Electronics
R. Newcomb

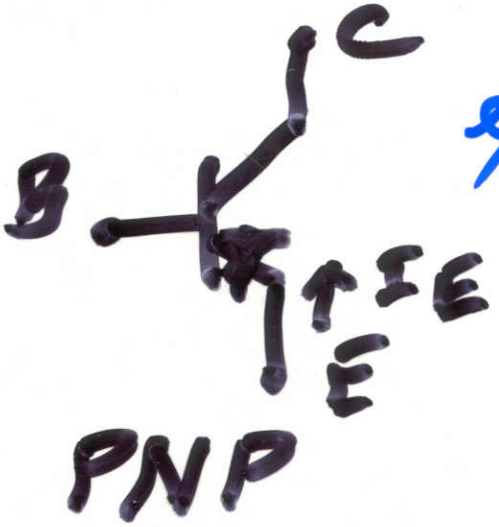
Key elements = transistors
BJT = bipolar junction
MOS = metal oxide silicon
CFET = field effect)
CMOS = complementary MOS
↓
PMOS, NMOS (enhancement
[depletion]
↓
NPN, PNP

circuit symbols

BJT



NPN



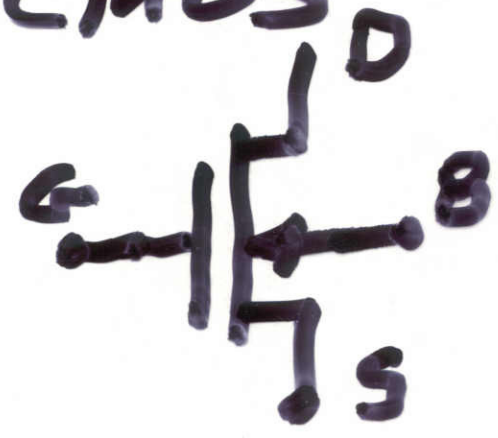
PNP

symmetric

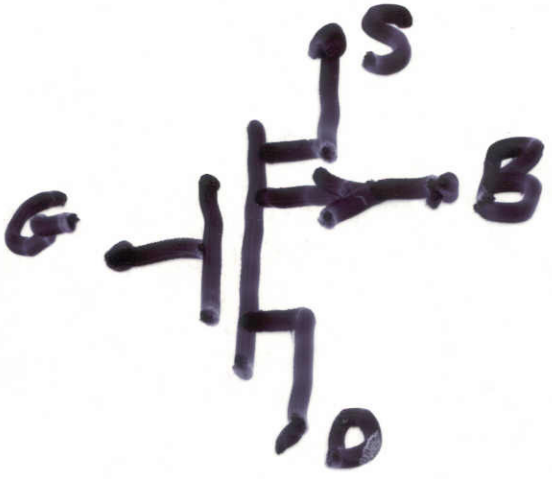
CCCS

B = base
C = collector
E = emitter

CMOS



NMOS



PMOS

G = gate

D = drain

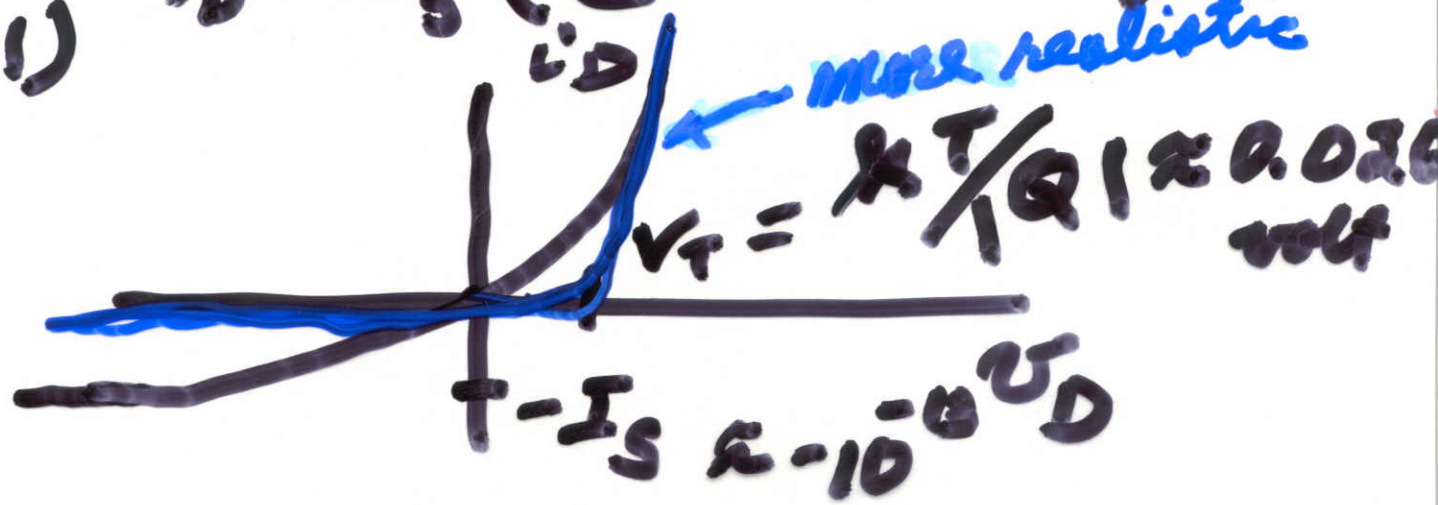
S = source

B = bulk

Diode:

Power diode = $v_D \cdot i_D$

P. 132 (3.1) $i_D = I_S\left(e^{v_D/(V_T \cdot m)} - 1\right)$

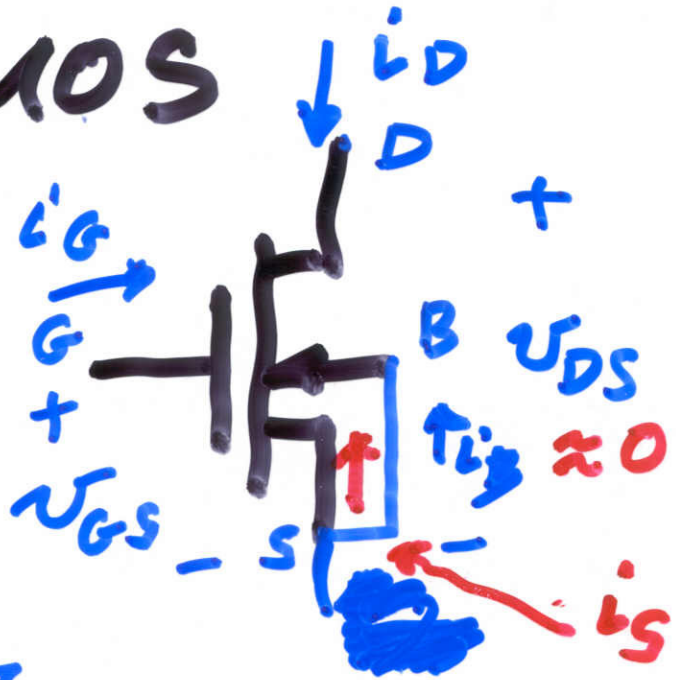


EE 302

08/31/00

v. 4

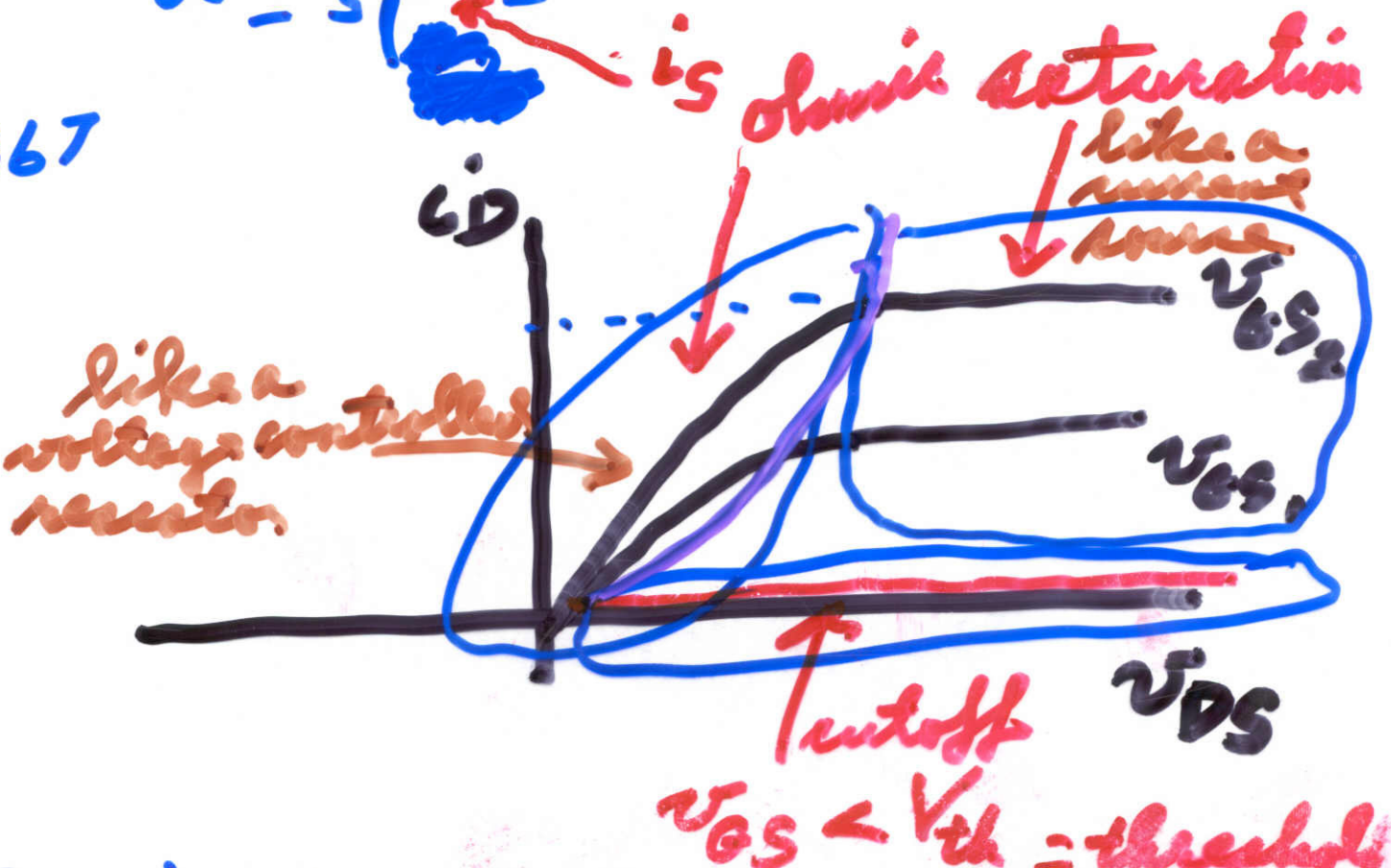
NMOS



VCCS

square law behavior

v. 36 T



$v_{GS} < V_{th}$ = threshold

3 regions

cutoff: $i_D = 0$; $v_{GS} < V_{th}$

$v_{DS} \geq 0$

saturation region

$$i_D = \frac{KP}{2}\cdot\frac{W}{L}(v_{GS}-V_{th})^2$$

F.363 (5.5) 5.

for $0 \le v_{DS}$

$0 \le v_{GS}-V_{th} \le v_{DS}$

a constant in v_{DS}

Ohmic (triode) region (F.363) (5.5a)

$$i_D = \frac{KP}{2}\cdot\frac{W}{L}\{2(v_{GS}-V_{th})v_{DS}-v_{DS}^2\}$$

for $0 \le v_{DS}$

$0 \le v_{DS} \le v_{GS}-V_{th}$